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Hispanic Students' Mathematics Achievement in Tennessee: Comparing with Asian Students

Yan Wang
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To the Graduate Council:

I am submitting herewith a thesis written by Yan Wang entitled "Hispanic Students' Mathematics Achievement in Tennessee: Comparing with Asian Students." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Teacher Education.

Vena Long, Major Professor

We have read this thesis and recommend its acceptance:

P. Mark Taylor, Jo Ann Cady

Accepted for the Council:
Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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and recommend its acceptance:

P Mark Taylor

John Cady

Accepted for the Council:

Vice Chancellor and
Dean of Graduate Studies

Hispanic Students' Mathematics Achievement in Tennessee: Comparing with Asian Students

A Thesis

Presented for the

Master of Science Degree

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Yan Wang

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ABSTRACT

The purpose of this study was to investigate mathematics achievement differences of Hispanic students and Asian students in terms of English proficiency, gender, grade level, and Socioeconomic Status (SES). Interactions between English proficiency and gender, English proficiency and SES, and English proficiency, gender, and SES were hypothesized. The mathematics scores of 6675 fourth and eighth- grade Hispanic and Asian students were selected from the 2005 Tennessee Comprehensive Assessment Program (TCAP) to explore achievement differences. Analysis of data revealed Asians significantly outscore Hispanics on the mathematics achievement test of the TCAP, regardless of English proficiency, gender, or SES. The difference between Asian male English Language Learner (ELL) with low SES and Hispanic male ELL with low SES at the fourth- grade was statistically significant albeit with a very small effect size. Analysis also showed that while the Asian ELL female scored higher than their male peers, the Hispanic ELL females scored lower than their male peers. In contrast, Asian non-ELL females scored lower than their male peers, the Hispanics non-ELL females scored higher than their male peers. By eighth-grade, Asian ELL female were scoring lower than their male peers, but the Hispanic ELL females still scored lower than their male peers. While the Asian non-ELL females scored higher than their male peers, the Hispanic non-ELL males scored higher than their female peers. Yet, these differences were not statistically significant. This study concludes that language, together with gender and SES had significant impact on math achievement of both Asian and Hispanic students.

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Chapter I

INTRODUCTION

As a result of a rapidly growing Hispanic population and the corresponding increase of Hispanic students in the public schools, the educational status of Hispanics has become a research topic in the United States.

Although Hispanics have high aspirations, for instance, they earn more credits in computer science, foreign languages, and English than other groups, they have few credits than others groups in mathematics, science, and history (ERIC Education Report 2001). Their overall educational attainment is consistently lower than that of other students (Carmen, 1996; De La Cruz, 1999; Fuson et al., 1997; Khisty, 1996; Lemke et al., 2004; Miller & Stigler, 1987; Stevenson, 1990; and Secada, 1991;). According to the National Center for Educational Statistics (NCES), Hispanics have made gains in enrollments and achievement in mathematics in the past 20 years. However, the National Assessment of Education Progress (NAEP) continues to show that White students outperform Hispanic students. For instance, Although the Hispanic students' average scale scores in mathematics were higher in 2004 than in 1973, specifically, the fourth-grade White-Hispanic score gap was significantly smaller in 2004 (18 points) than it was in 1999 (26 points), and the eighth- grade White-Hispanic score gap decreased from 35 points in 1973 to 23 points in 2004. Nevertheless, there was no significant difference in the score gap between the first and most recent assessment years. In other words, Despite some gains, gaps in the academic performance between Hispanic and non-Hispanic students remain (The Nation's Report Card 2005).

Numerous theories have been offered a variety of factors to explain Hispanic students low mathematics achievement. These theories include poverty, lack of participation in preschool programs, attendance at poor quality elementary and high schools, and limited English proficiency. Among these factors, the socioeconomics status (SES) has a strong impact on students' achievement (Bradby 1992; Carmen, 1996; Krashen &Brown, 2005; Secada, 1992; and Tate, 1997). Moreover, teachers and policy makers largely adhere to the notion that the language issue in particular is the major problem (Abedi, 2001; Buchanan and Helman, 1993; De La Cruz, 1999; Gustin, 2003; Lee & Jung, 2004; Khisty, 2002; Ruiz, 1988; and Secada, 1991).

Since the National Council of Teachers of Mathematics (NCTM) has articulated a vision to students, school leaders, parents and other caregivers the responsibility to ensure that *all* students receive a ***high-quality*** mathematics education (NCTM 2000). This vision has been intensified by the passage of the No Child Left Behind Act (NCLB 2002). NCLB requires every state to implement assessment systems that annually measure the academic skills of *all* students, including English Language Learners (ELLs) (Abella, et al., 2005). As a result, many researchers have worried that ELL students are lumped together into an accountability system that not only fails to provide a level playing field, but that puts them at a severe disadvantage (Brown 2005).

However, other research recently shows the positive aspects with regard to Hispanic students' math achievement. Escamilla examined existing data from the state of Colorado and revealed that Hispanic students in English-language acquisition/bilingual classrooms are among the highest performing students in their schools (Escamilla et al., 2005). Furthermore, findings from his study indicate that teachers and policy makers

largely adhere to the language-as-a-problem paradigm. Therefore, he suggested that teacher educators and teachers be more critical in interpreting the results from high-stakes tests. Consequently, the relationship between Hispanics students' English proficiency and mathematics achievement is equivocal.

Research Objectives and Approaches

The purpose of this study is to examine the relationship among Hispanics students' mathematics achievement, language proficiency, and socioeconomics status in comparison to those of another language minority group—Asian students. Asian and Hispanic students are both language minority students in the United States, it has long been recognized that Asian students performed significantly better in mathematics than Hispanic students (Carmen 1996). This study seeks to compare Hispanic students' and Asian students' mathematics achievement at the state level, and to find differences and similarities between these two groups.

There are studies of Hispanic math performance in other states, but Hispanic students in Tennessee have not been studied. Reasons for studying the performance of Hispanic students include:

a) The State of Tennessee has one of the largest percentage increases in Hispanic population in the nation (278%) (Pew Hispanics Center 2005);

b) Understanding their performance and identifying potential problems could help educators improve the performance of Hispanics;

c) This contribution to the nationwide study will help to better understand the performance of Hispanic students.

Much research conducted in the past has found that gender is an important factor in students' achievement in schools. However, this factor has not been examined in previous Hispanic student studies (Bradby, 1992; Carmen, 1996; and Tate, 1997). This study builds upon research that has already been conducted, exploring the mathematics achievement of Hispanic and Asian student with regard to gender, English proficiency, socioeconomic status (SES) and grade level. The findings will provide suggestions on how to address the Hispanics students' mathematics learning needs in Tennessee.

The approach of this study is using data from the 2005 Tennessee Comprehensive Assessment Program (TCAP) achievement test, which has a collection of mathematics scores based on students categorized by their English proficiency, gender, and family economic. The TCAP mathematics achievement test scores for students in grades fourth-grade and eighth- grade will be analyzed to find any differences and similarities between Asian and Hispanic students.

Research Questions

The study investigates the two questions:

1. How do mathematics achievements as measured by the TCAP test vary by English proficiency, SES, ethnicity (Asians & Hispanics), and Gender in fourth-grade?

2. How do mathematics achievements as measured by the TCAP test vary by English proficiency, SES, ethnicity (Asians & Hispanics), and Gender in eighth-grade?

Chapter II

REVIEW OF THE LITERATURE

English Proficiency and Mathematics Achievement

Language is believed to be one of the most important problems that contribute to a gap in mathematics achievement for English language learners (Buchanan and Helman, 1993; De La Cruz, 1999; Gustin, 2003; Khisty, 2002; Lee & Jung, 2004; Ruiz, 1988; and Secada, 1991). Hispanic and Asian students, especially those who had mathematics experiences in their home country, must filter their math knowledge-a language all its own—through a second language, English. So, in this case, math becomes the "third" language. Students face an extra challenge (Chamot & O'Malley 1994). Specially, the older students are influenced to a greater extent by the language of the test, since they have received more years of academic instruction in their home language, prior to being tested in English (Carmen 1992). To investigate the language status of Asians and Hispanics, Kaufman and his colleagues found that similar proportions of all 1988 eighth-grade Asians and Hispanics were categorized as Limited English Proficiency (LEP) (6 and 8 percent, respectively). However, Hispanics were more likely to come from homes where a language other than English was spoken (66 percent versus 55 percent for Asians).Therefore, students with language backgrounds different from English need special help in adapting to a mathematics class conducted in English (Cuevas 1990).

On the other hand, some of the researchers imply that "language handicaps" can not be used to explain the mathematics achievement gap (Bradby 1992; Escamilla et al., 2005). When Bradby explored how language usage and ability affected Hispanic and

Asian students' academic achievements, he found that being a language minority student does not explain the differences in mathematics achievement of Hispanic eighth-graders. However, the level of English proficiency was positively related to mathematics achievement. Students with a moderate level of English proficiency were better able to achieve a basic level of mathematics performance than students classified as low English proficient. Thus, a moderate level of English proficiency appears to matter. He indicated, however, that the relationship between English proficiency and mathematics performance did not exist for Asian American students (Bradby 1992). Escamilla (2005) argued that we have been so socialized to believe the language-as-a-problem paradigm that we have difficulties seeing and understanding counterevidence. He concluded that the view that language is a problem in need of remediation is pervasive.

Gender, SES, Ethnicity and Mathematics Achievement

The gender issue has long been recognized to be one of the most important factors in mathematics achievement. Research suggests that gender gaps favoring males tend to increase as age increases and tend to be largest for high-performing students (Lubienski, McGraw, et al., 2004). According to her study, Hopkins found that the gender difference in mathematics achievement is pervasive across SES levels, school locale and school location. Moreover, females are achieving higher in mathematics in the middle school years while males are achieving higher at the high school level (Hopkins, 2004). Yet, in his cross-national comparison study, Lemke (Lemke et al., 2004) found that males outperformed females in mathematics literacy in United States classrooms.

A strong relationship exists between SES and mathematics achievement (Tate 1997). According to Carmen (1996), there is a positive relationship between SES and

mathematics achievement with Asian and Hispanics students. The fourth- grade Hispanics students were more likely than their Asian peers to attend schools that reported 51 percent to over 90 percent of the students on subsidized lunch benefits. In addition, the percentage of fourth- grade Hispanic students attending schools that reported seventy-six to ninety percent of students on subsidized lunch was about 40 percent higher than the percentage of fourth- grade Asian students that attended comparable schools. A similar pattern emerges from the eighth- grade student data. Hispanic students were more likely to report that they attended schools with twenty-six to ninety percent of students on subsidized lunch, and Asian students more likely to report that they attended schools with 11 percent or less on subsidized lunch. These facts confirm reports that attest to the growing isolation of Hispanic students and their overrepresentation in poorer schools. Consequently, there is an urgent need to address the mathematics achievement of low-SES students.

High-stakes Test and Mathematics Achievements

Kohn (2000) contends that high-stakes testing marks a major retreat from fairness, accuracy, and quality for students, especially, for language minority students (Abella et. al., 2005; Kohn, 2000). Linguistic and cultural barriers are acting as inhibiting factors. The tests were created for one populations of students (e.g., native, English-speaking, middle-class students) and are being used on populations of students for whom they were not intended (Escamilla et al., 2005). Therefore, the use of "valued, scientific" instruments produces knowledge viewed as "legitimate and objective" serves to justify student deficits, especially for special populations such as English Language Learners (ELLs).

Even though high-stakes testing offers validity and reliability, enculturation encompasses many nuances that most likely affect ELL student performance on achievement tests. Abella found that ELL students approach achievement tests with limited knowledge of the new country's idioms and social experiences, and they have idiosyncratic conceptions of the test-taking experiences (Abella et al., 2005). Abella shows that ELL students' achievement test results in English are not always valid assessments of their content-area knowledge. ELL students answer more items correctly on a home-language mathematics test than on a comparable English-language test, regardless of their level of English-language proficiency or their grade level. This effect is more pronounced among secondary students (Abella et al., 2005). Brown suggests that these results indicate that meaningful and equitable assessment of ELL students in system-wide assessment is critical. Because without assessment that allows ELL students to be tested equitably, these students will be perpetual losers in a system in which they do not receive a fair chance (Brown 2005). In summary, given that the high-stakes tests often confound language and academic skills, the only method for disentangling the effect of language and mathematics knowledge is to give the same test to the same students in both English and the home language (Abedi & Dietel, 2004; Solano-Flores & Trumbull, 2003).

Chapter III

PROPOSED METHODOLOGY

Participants

For this study, the records of 6675 4th and fourth- grade Hispanic and Asian students were selected from the spring 2005 TCAP Achievement Mathematics test score data set in the State of Tennessee. Students identified as special needs were not included in this study. Information was obtained from the Tennessee Department of Education on students' English proficiency classification, grade level, gender, ethnicity, and socioeconomic status (SES). Since the socioeconomic status emerged as an important factor in most study (Brown, 2005; Bradby, 1992; Carmen, 1996; and Tate, 1997), the economic disadvantaged (ED) and economic not disadvantaged (END) are considered within each group to be a variable on the test scores.

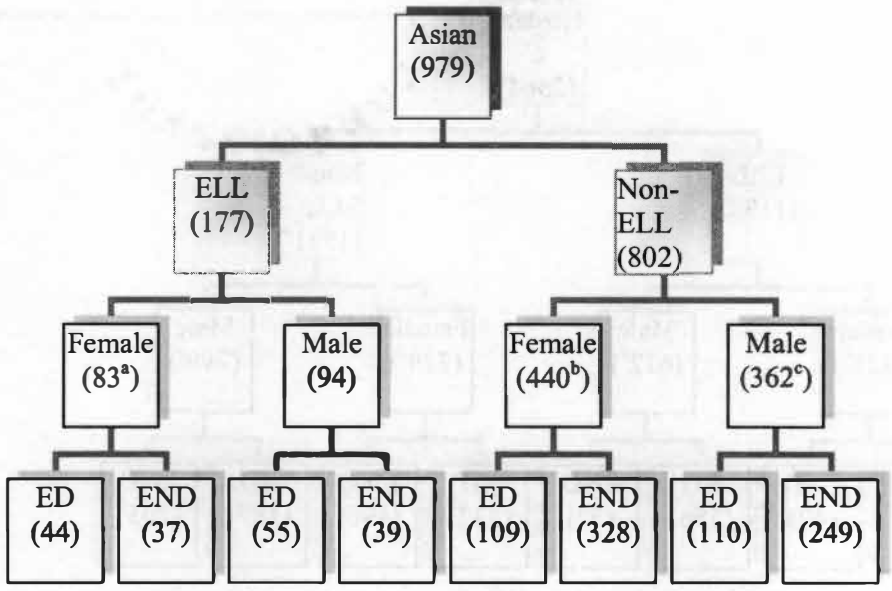
In 2005, a total of 3643 fourth- grade and 3032 eighth- grade Hispanics and Asian students took the TCAP. Table 3.1 and 3.2 contains demographics of students who were selected for the study. Hispanic and Asian students were categorized according to gender, grade, and SES status. This produced sixteen subgroups for each grade: (1)Asian (or Hispanic) ELL female students with ED, (2) Asian (or Hispanic) ELL female students with END, (3) Asian (or Hispanic) ELL male students with ED, (4) Asian(or Hispanic) ELL male students with END, (5) Asian (or Hispanic) Not-ELL female students with ED, (6) Asian(or Hispanic) Not-ELL female students with END, (7) Asian(or Hispanic) Not-ELL male students with ED, and (8) Asian (or Hispanic) Not-ELL male students with END (See Figure 3.1, 3.2, 3.3, and 3.4).

Table 3.1 *Gender, Economic disadvantage, and Ethnicity of English Language Learners (ELLs) and not English Language Learners (non-ELLs) in fourth- grade*

		ELLs		non-ELLs	
		n_1	%	n_2	%
Gender	Male	706	53.9	1161	49.8
	Female	604	46.1	1169	50.2
Economic disadvantage	Yes	1124	86.4	1338	57.8
	No	177	13.6	978	42.2
Ethnicity	Asian	177	13.5	802	34.4
	Hispanic	1133	86.5	1531	65.6
Grand total		1310	100	2333	100

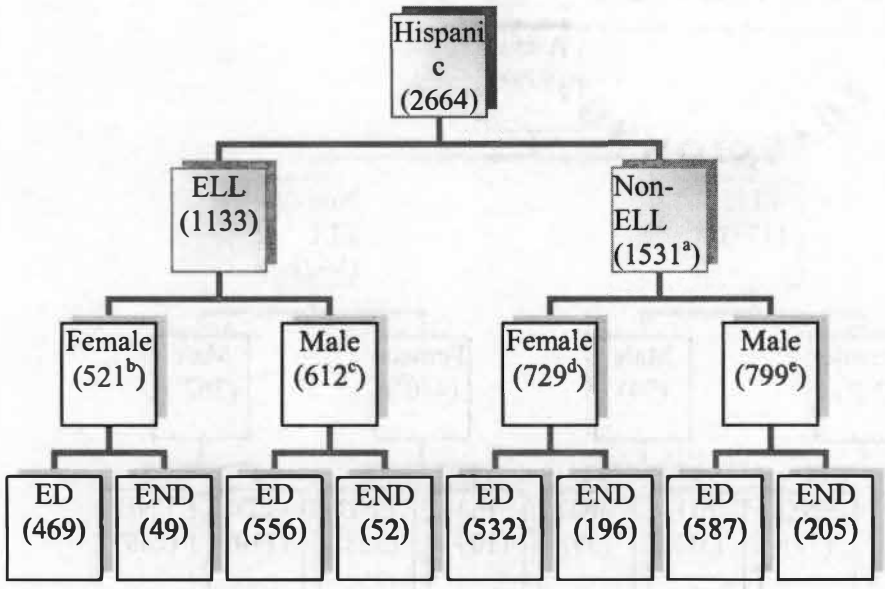
Table 3.2 *Gender, Economic disadvantage, and Ethnicity of English Language Learners (ELLs) and not English Language Learners (non-ELLs) in eighth- grade*

		ELLs		non-ELLs	
		n_1	%	n_2	%
Gender	Male	468	50.8	1090	51.7
	Female	453	49.2	1019	48.3
Economic disadvantage	Yes	720	78.7	1071	51.0
	No	195	21.3	1027	49
Ethnicity	Asian	153	16.6	719	34.1
	Hispanic	769	83.4	1391	65.9
Grand total		922	100	2110	100



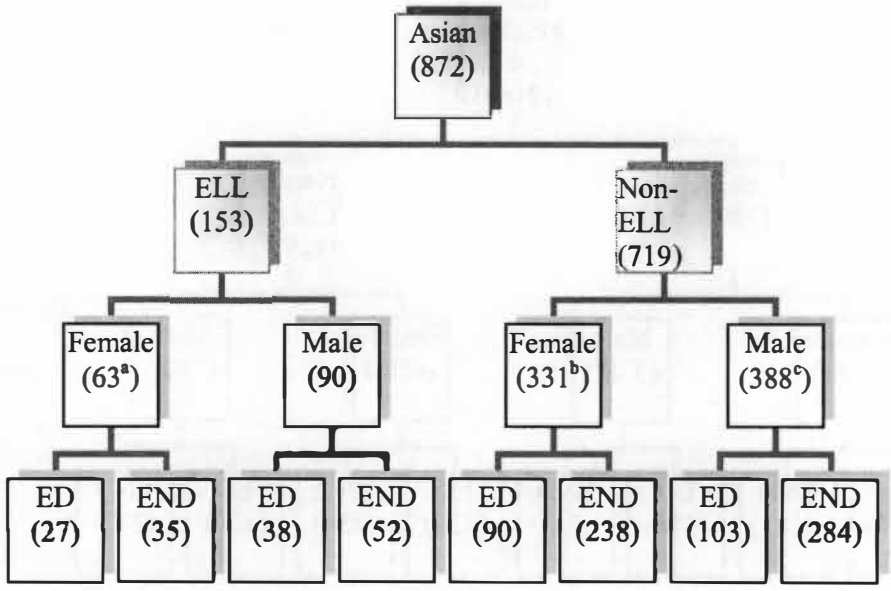
Note: [a]*Two Asian female ELL did not report their SES;*
[b]*Three Asian female non-ELLs did not report their SES;*
[c]*Three Asian male non-ELLs did not report their SES;*

Figure 3.1 *Fourth- grade Asian student subgroups in terms of Language proficiency, gender, SES*



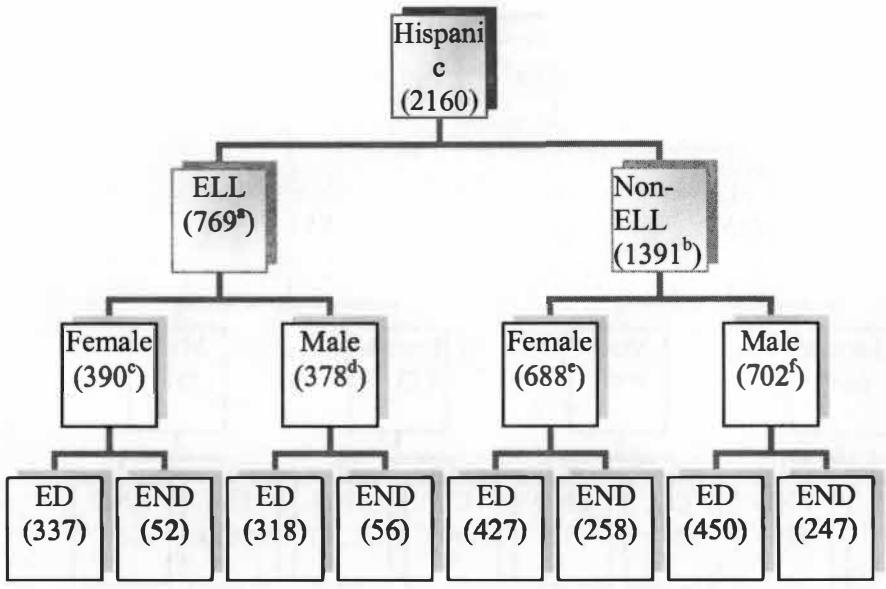
Note: [a]*Three Hispanic non-ELLs did not report their gender status;*
[b]*Three Hispanic female ELLs did not report their SES;*
[c]*Three Hispanic male ELLs did not report their SES;*
[d]One *Hispanic female non-ELL did not report their SES;*
[e]*Seven Hispanic male non-ELLs did not report their SES;*

Figure 3.2 *Fourth- grade Hispanic student subgroups in terms of Language proficiency, gender, SES*



Note: [a]*One Asian female ELL did not report their SES;*
[b]*Three Asian female non-ELLs did not report their SES;*
[c]*One Asian male non-ELL did not report their SES;*

Figure 3.3 *Eighth- grade Asian student subgroups in terms of Language proficiency, gender, SES*



Note: [a]*One Hispanic ELLs did not report their gender status;*
[b]*One Hispanic non-ELL did not report their gender status;*
[c]*One Hispanic female ELL did not report their SES;*
[d]*Four Hispanic male ELLs did not report their SES;*
[e]Three *Hispanic female non-ELLs did not report their SES;*
[f]*Five Hispanic male non-ELLs did not report their SES;*

Figure 3.4 *Eighth- grade Hispanic student subgroups in terms of Language proficiency, gender, SES*

Hypotheses

Prior research suggests the research questions should hypothesize significant difference in Asian and Hispanic students will be accounted for by students' English proficiency, gender, and SES at fourth and eighth-grades.

1. The non-ELL and ELL Asian students would have significantly higher scores on mathematics achievement test than Hispanics students.
2. The non-ELL and ELL Asian female students would have significantly higher scores on mathematics achievement test than those of Hispanics students,
3. The non-ELL and ELL Asian male students would have significantly higher scores on mathematics achievement test than those of Hispanics students,
4. The non-ELL and ELL Asian high SES would have significantly higher scores on mathematics achievement test than those of Hispanics students,
5. The non-ELL and ELL Asian students with low SES would have significantly higher scores on mathematics achievement test than those of Hispanics students,
6. The non-ELL and ELL Asian female students with high SES would have significantly higher scores on mathematics achievement test than Hispanics students,
7. The non-ELL and ELL Asian female students with low SES would have significantly higher scores on mathematics achievement test than Hispanics students,
8. The non-ELL and ELL Asian male students with high SES would have significantly higher scores on mathematics achievement test than Hispanics students,

9. The non-ELL and ELL Asian male students with low SES would have significantly higher scores on mathematics achievement test than Hispanics students,

Data Analysis

The study is to test the significance of the difference between Asian female (or male) ELL (or non-ELL) students with ED (or END) and Hispanic female (or male) ELL (or non-ELL) students with ED (or END). A *t*-test was performed to determine if a significant difference occurred in the mathematics achievement. The tool uses $p < .05$ as the benchmark for determining statistical significance. To determine how strong or how important the results are, the Cohen's *d* effect sizes was used, which is computed by dividing the difference between the means of two samples by the standard deviation of the combined population sample. The Cohen's d used in this study is complicated slightly by the fact that not only the males and females will be compared but also the English proficiency and SES within ethnic groups as well. According to Cohen (1992), effects sizes of 0.2 are "small," effects of 0.5 are "medium," and effects of 0.8 are "large". The Microsoft Office Excel was used to calculate t value and effect size.

Chapter IV

RESULTS

Achievement Difference in Math by English Proficiency and Ethnicity

The results of the TCAP mathematics achievement test with fourth and eighth-grade scores showed that the Asian students scored higher than their Hispanic peers regardless of level of English proficiency.

Grade 4

As Table 3 shows, the mean score of Asian fourth- grade ELL students was 490.46 (SD = 32.53), while the mean for the Hispanics ELL group was 467.86 (SD =32.78). Effect size was calculated and revealed that the limited language proficiency has medium effect (0.69) on the mathematics differences between the Asian ELL and Hispanics ELL group. The mean score of Asian fourth- grade non-ELL students was 520.58 (SD = 38.12), while the mean for the Hispanics non-ELL group was 492.71 (SD=30.95). Effect size were calculated and revealed that the proficient language skill has a large effect (0.90) on the mathematics differences between the Asian non-ELL group and Hispanics non-ELL group (See Table 4.1).

Grade 8

At eighth-grade, the overall mean scores of Asian ELL students (553.48) was significantly higher than that of Hispanics ELL students (497.18), with a large effect size of 1.25. Significant differences in mean scores favoring Asian non-ELL students (584.58) at the eighth- grade level also occurred, with a large effect sizes of 0.96. A summary of this data is shown in Table 4.2.

Table 4.1 Fourth- grade *Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian and Hispanics students on the TCAP mathematics achievement test*

	ELL students				Non-ELL students			
Fourth grade	**M**	**S.D.**	**t (1308*)**	**Cohen's d**	**M**	**S.D.**	**t (2331*)**	**Cohen's d**
Hispanic	467.86	32.77	8.54	0.69	492.71	520.58	19.04	0.9
Asian	490.46	32.53			30.95	38.12		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*

Table 4.2 *Eighth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian and Hispanics students on the TCAP mathematics achievement test*

	ELL students				Non-ELL students			
Eighth grade	**M**	**S.D**	**t (920*)**	**Cohen's d**	**M**	**S.D**	**t (2108)**	**Cohen's d**
Hispanic	497.18	45.01	13.46	1.25	543.78	42.37	19.03	0.96
Asian	553.48	57.1			584.58	54.07		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*

The first hypothesis stated that non-ELL Asian students would have significantly higher scores on mathematics achievement test than Hispanics students, and the ELL Asian students would have significantly higher scores on mathematics achievement test than Hispanics students. The results of independent sample t-test supported this hypothesis.

Achievement Difference in Math by English Proficiency, Gender, and Ethnicity

Analyzing 2005 TCAP mathematics achievement data by the interaction of English proficiency, gender, and Ethnicity, large significant differences favoring Asian students were found at the fourth- grade and eighth- grade level. However, when comparing the test scores within each group, different results existed.

Grade 4

On the one hand, there were significant differences between the Asian ELL female students and Hispanic ELL female students (effect size of 0.87), and the difference between the Asian ELL male students and Hispanic ELL male students exited (effect size of 0.55), respectively. Also the Asian non-ELL female and male students scored significantly higher (effect size of 0.82 and 1.00) than those of Hispanic ELL female and male students (see Table 4.3 and 4.4).

To examine gender issue within each ethnic group, the Table 4.5 and 4.6 showed that while the Asian ELL female scored higher than their male peers, the Hispanic ELL female scored lower than their male peers. While Asian non-ELL female scored lower than their male peers, the Hispanics non-ELL female scored higher than their male peers, with very small effect size.

Table 4.3 *Fourth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian and Hispanics female students on the TCAP mathematics achievement test*

	ELL& female				Non-ELL& female			
Fourth-grade	**M**	**S.D.**	**t (602*)**	**Cohen's d**	**M**	**S.D.**	**t (1167)**	**Cohen's d**
Hispanic	466.82	31.24	7.25	0.87	493.02	31.38	12.43	0.82
Asian	493.93	34.06			518.66	38.35		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*

Table 4.4 *Fourth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian and Hispanics male students on the TCAP mathematics achievement test*

	ELL & Male				Non-ELL& Male			
Fourth-grade	**M**	**S.D.**	**t (704*)**	**Cohen's d**	**M**	**S.D.**	**t 1159)**	**Cohen's d**
Hispanic	468.75	34.02	5.00	0.55	492.52	30.53	14.55	1.00
Asian	487.39	30.97			522.90	37.77		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*

Table 4.5 *Fourth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian female and male students on the TCAP mathematics achievement test*

	ELL students				Non-ELL students			
Fourth-grade	M	SD	t (175)	Cohen's d	M	SD	t (800)	Cohen's d
Asian female	493.93	487.39	1.34	0.21	493.02	518.66	-1.57	-0.112
Asian male	34.06	30.97			31.38	38.35		

**Degree of freedom, M.: Mean, SD: Standard deviation, P <.o5*

Table 4.6 *Fourth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Hispanic female and male students on the TCAP mathematics achievement test*

	ELL students				**Non-ELL students**			
Fourth-grade	**M**	**SD**	**t (1131*)**	**Cohen's d**	**M**	**SD**	**t (1526)**	**Cohen's d**
Hispanic female	466.82	31.24	-0.99	-0.057	493.02	31.38	0.31	0.02
Hispanic male	468.75	34.02			492.52	30.53		

**Degree of freedom, M.: Mean, SD: Standard deviation, P <.o5*

Grade 8

Although the mean score of Asian ELL female and male students was significantly higher than Hispanic ELL female and male students, and the mean score of Asian non-ELL female and male students was significantly higher (effect size of 1.03) than Hispanic ELL female and male students (See Table 4.7 and 4.8), as Table 4.9 and 4.10 indicated that there were no significant differences within each ethnic group with regard to gender achievement, with very small effect size. In eighth-grade, Asian ELL females were now scoring lower than their male peers and the Hispanic ELL females were scoring lower than their male peers (as they did at fourth-grade). While the Asian non-ELL females scored higher than their male peers, the Hispanic male non-ELL scored higher than their female peers. Therefore, Asians and Hispanics have different trends on math achievement in terms of gender.

Achievement Difference in Math by English Proficiency, SES, and Ethnicity

Grade 4

Socioeconomic status (SES) is found to be strongly related to mathematics achievement among Hispanic fourth- grade students when compared with Asian students. In addition, the interaction of SES and language proficiency has a strong impact on mathematics achievement of Asians and Hispanics.

At fourth-grade, the mean and Standard deviation for the Asian ELL identified as ED was 481.25 and 28.48 respectively. The mean and Standard deviation for the Hispanics ELL identified as ED was 468.05 and 31.32 respectively. There are significant difference between the Asian and Hispanics ELL identified with ED, with a small effect size .42) (See Figure 4.1).

Table 4.7 *Eighth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian and Hispanics female students on the TCAP mathematics achievement test*

	ELL& Females				Non-ELL& Females			
Eighth grade	**Mean**	**S. D.**	**t (451*)**	**Cohen's d**	**Mean**	**S. D.**	**t (1017)**	**Cohen's d**
Hispanic	495.03	549.84	8.90	1.24	543.95	39.68	13.80	1.03
Asian	44.11	52.53			584.71	52.29		

**Degree of freedom, M.: Mean, SD: Standard deviation, P <.o5*

Table 4.8 *Eighth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian and Hispanics male students on the TCAP mathematics achievement test*

	ELL & Male				Non-ELL& Male			
Eighth grade	**M**	**S. D.**	**t (466*)**	**Cohen's d**	**M**	**S. D.**	**t (1088)**	**Cohen's d**
Hispanic	499.315	45.91	9.87	1.24	543.60	44.91	13.19	0.91
Asian	556.02	60.32			584.46	55.627		

**Degree of freedom, M.: Mean, SD: Standard deviation, P <.o5*

Table 4.9 *Eighth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian female and male students on the TCAP mathematics achievement test*

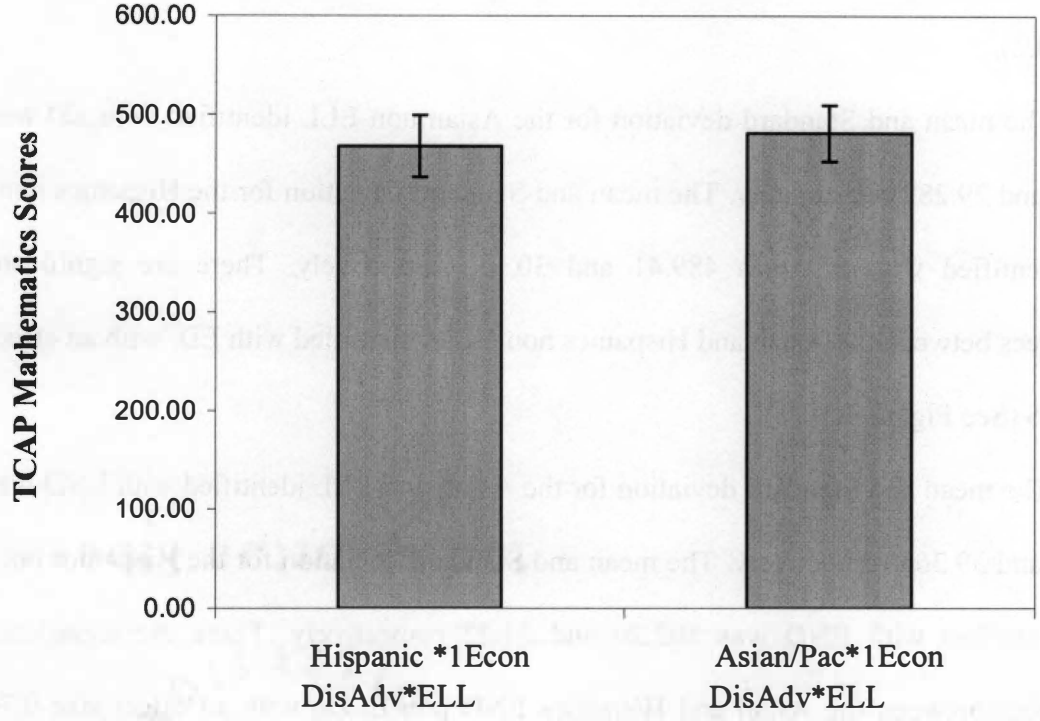
	ELL students				Non-ELL students			
Eighth-grade	**M**	**SD**	**t (151*)**	**Cohen's d**	**M**	**SD**	**t (717)**	**Cohen's d**
Asian female	549.84	556.02	-0.66	-0.10	584.71	584.46	0.06	0.00
Asian male	52.53	60.32			52.29	55.62		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*

Table 4.10 *Fourth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Hispanic female and male students on the TCAP mathematics achievement test*

	ELL students				Non-ELL students			
Fourth-grade	**M**	**SD**	**t (766*)**	**Cohen's d**	**M**	**SD**	**t (1388)**	**Cohen's d**
Hispanic female	495.03	44.11	-1.32	-0.09	543.95	39. 68	0.15	0.00
Hispanic male	499.32	45.91			543.60	44.91		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*



Note: Error bar represent SD

Figure 4.1 *Comparisons of fourth- grade Asian and Hispanics Students' Mathematics mean scores by ELL and Economic Disadvantages*

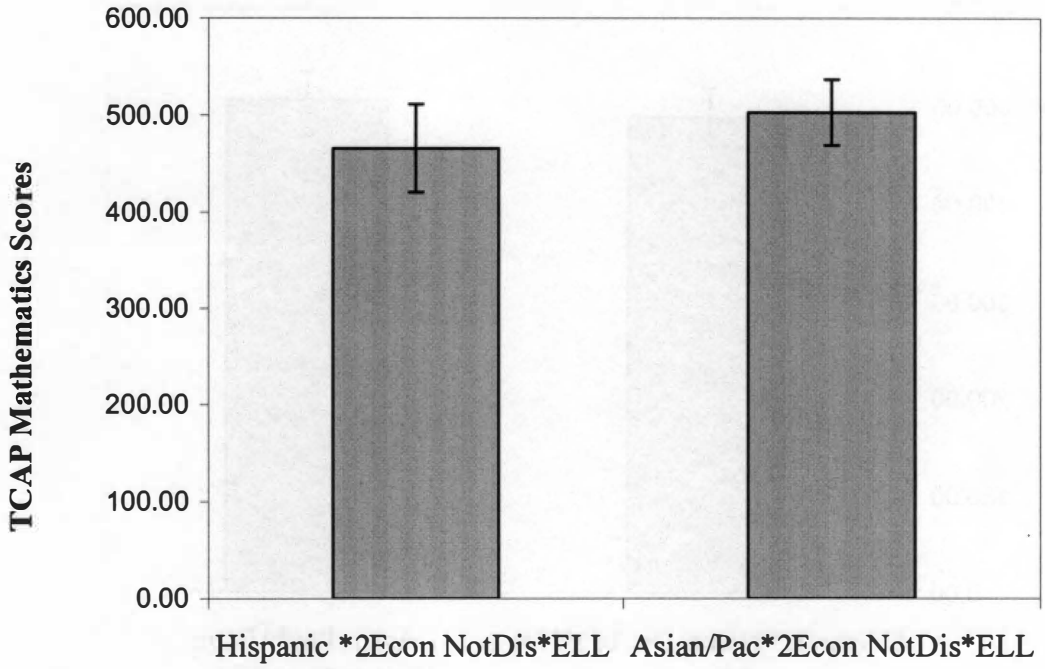
The mean and Standard deviation for the Asian ELL identified with END was 502.88 and 33.846 respectively. The mean and Standard deviation for the Hispanics ELL identified with END was 465.86 and 45.37 respectively. There are significant differences between the Asian and Hispanics END ELLs, with an effect size 0.82 (effect size) (See Figure 4.2).

The mean and Standard deviation for the Asian non-ELL identified with ED was 506.32 and 29.282 respectively. The mean and Standard deviation for the Hispanics non-ELL identified with ED was 489.41 and 30.13, respectively. There are significant differences between the Asian and Hispanics non-ELLs identified with ED, with an effect size 0.56 (See Figure 4.3).

The mean and Standard deviation for the Asian non-ELL identified with END was 525.97 and 39.364 respectively. The mean and Standard deviation for the Hispanics non-ELL identified with END was 502.26 and 31.22 respectively. There are significant differences between the Asian and Hispanics END non-ELLs, with an effect size 0.76 (See Figure 4.4).

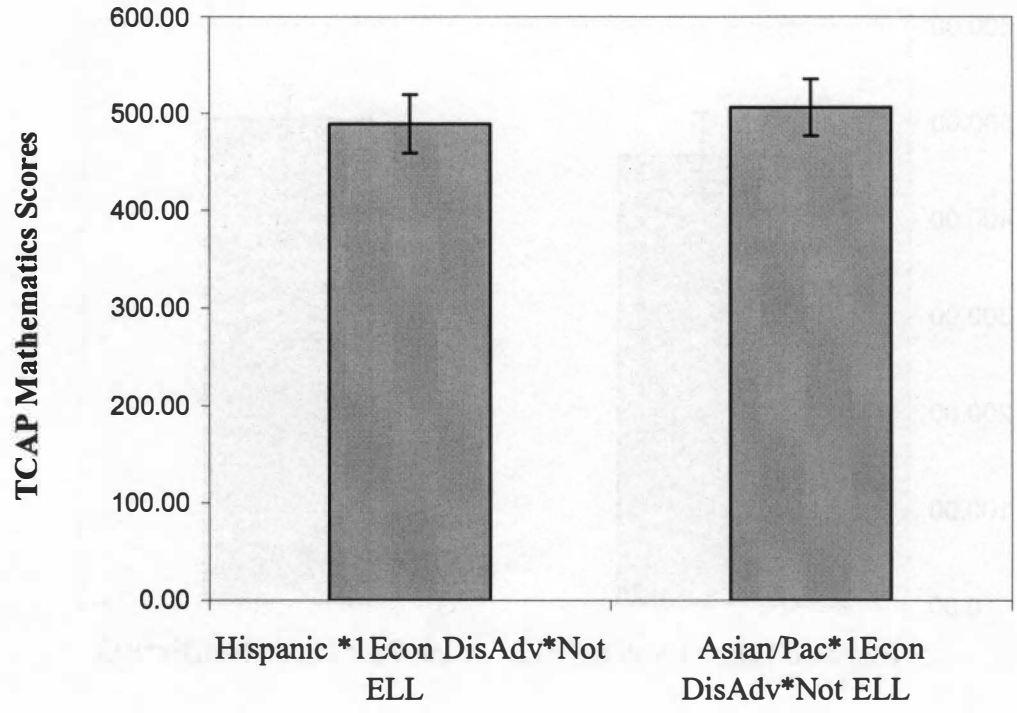
Grade 8

The mean and Standard deviation for the Asian ELL students with ED status was 535.71 and 60.64 respectively. The mean and Standard deviation for the Hispanics ELL students as ED status was 497.31 and 45.57 respectively. There are significant differences between the Asian and Hispanics ELLs who were identified as ED, with an effect size 0.84 (See Figure 4.5). There was, however, a significant difference between Asian ELL students who were identified as END (566.55) and Hispanics ELL students



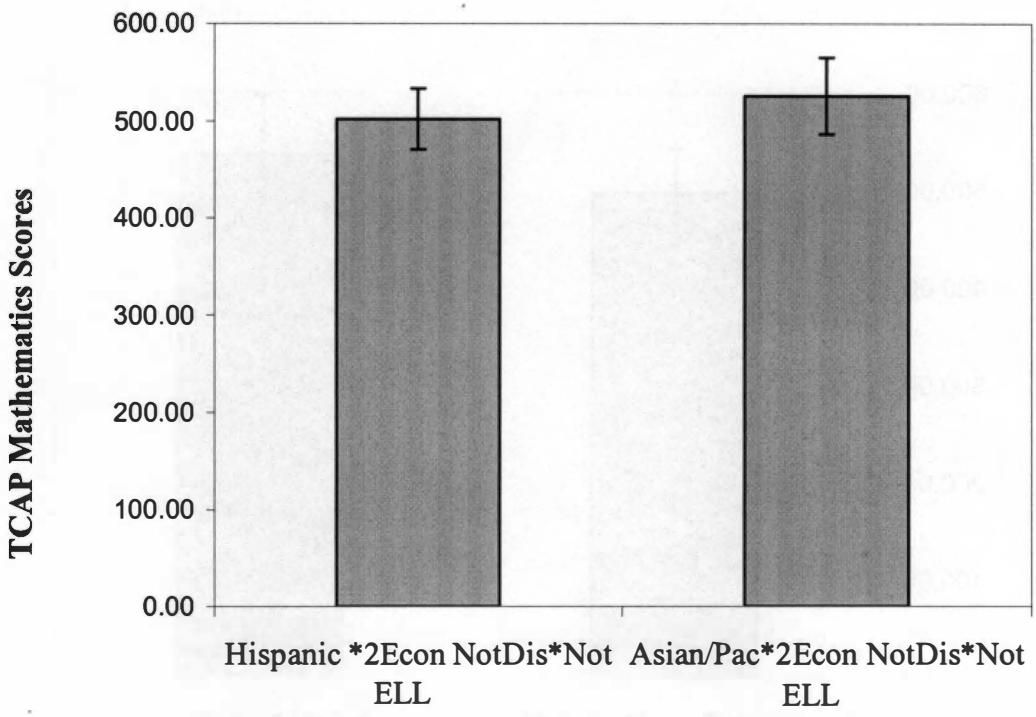
Note: Error bar represent SD

Figure 4.2 *Comparison of fourth- grade Asian and Hispanics Students' Mathematics mean scores by ELL and Economic not Disadvantages*



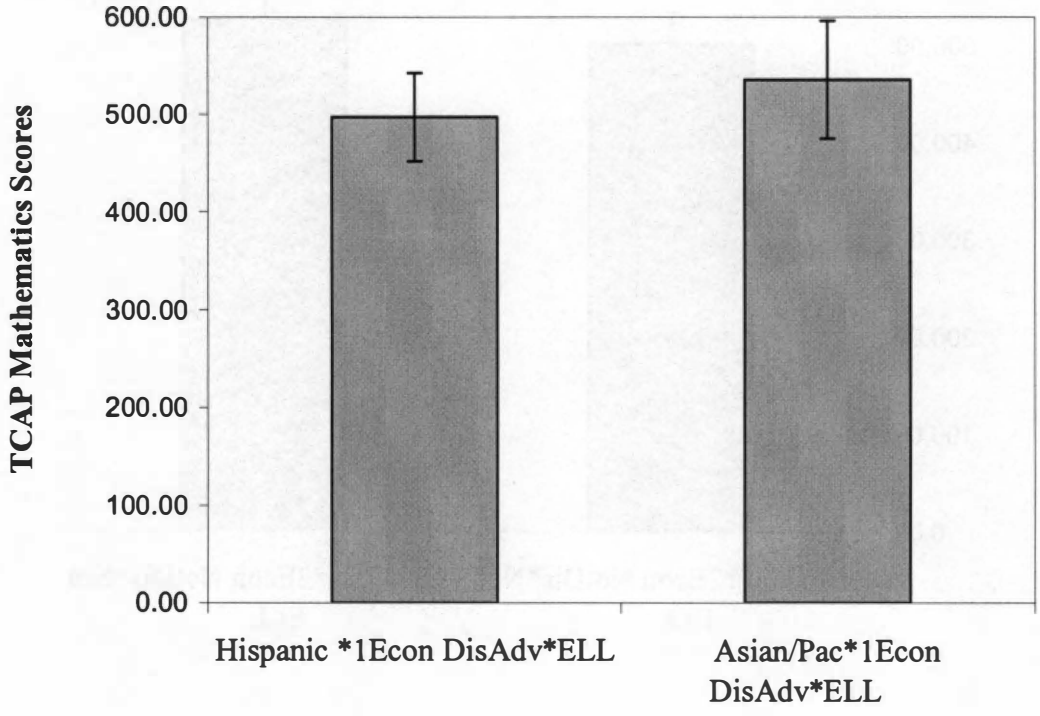
Note: Error bar represent SD

Figure 4.3 *Comparison of fourth- grade Asian and Hispanics Students' Mathematics mean scores by non-ELL and Economic Disadvantages*



Note: Error bar represent SD

Figure 4.4 *Comparisons of fourth- grade Asian and Hispanics Students' Mathematics mean scores by Non-ELL and Not Economic Disadvantage*



Note: Error bar represent SD

Figure 4.5 *Comparisons of eighth- grade Asian and Hispanics Students' Mathematics mean scores by ELL and Economic Disadvantage*

who were identified as END (537.72). The effect size was substantial (d=1.74) (See Figure 4.6).

As Figure 4.7 shows, the mean and Standard deviation for the Asian non-ELL students with ED status was 561.03 and 43.46 respectively. The mean and standard deviation for the Hispanics non-ELL students with ED status was 496.39 and 40.33. There were significant difference between the Asian and Hispanics ED non-ELLs, yet, the low SES and proficient language skills have medium effect on this difference. A significant difference was found between Asian non-ELL students identified with END and their Hispanics peers. The effect size was substantial (d= 0.91) (See Figure 4.8).

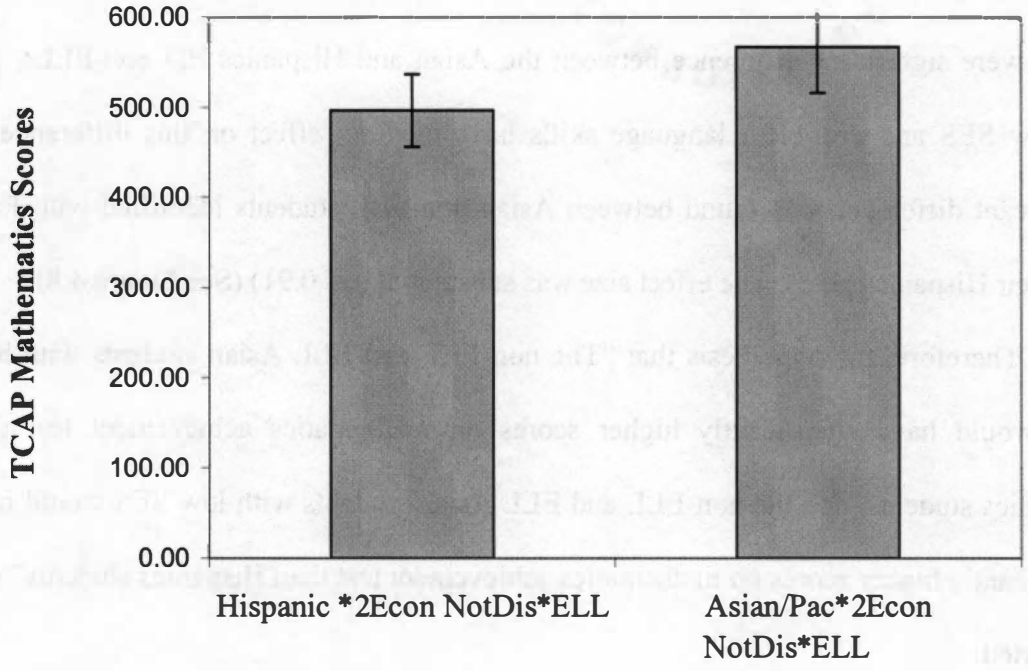
Therefore, the hypothesis that "The non-ELL and ELL Asian students with high SES would have significantly higher scores on mathematics achievement test than Hispanics students, and the non-ELL and ELL Asian students with low SES would have significantly higher scores on mathematics achievement test than Hispanics students" was supported.

Math Achievement Difference by English Proficiency, Gender, SES, and Ethnicity

Grade 4

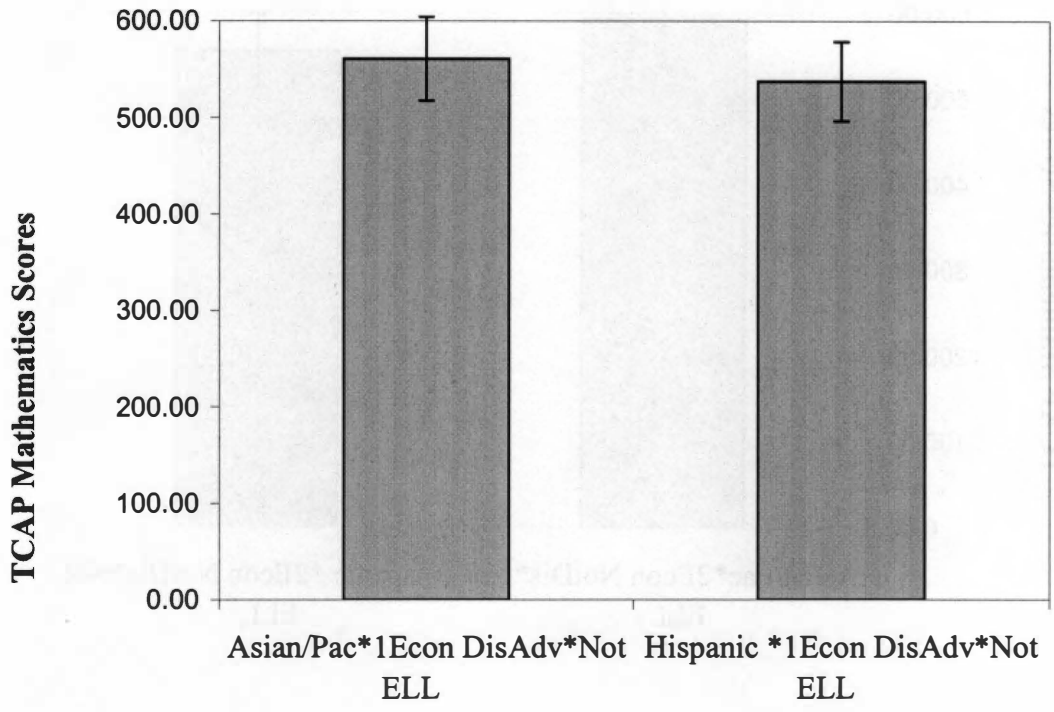
An independent samples t-test indicated that the significant group difference between Asian female ELLs and Hispanics female ELLs who were identified with ED status ($t [511] = 3.58$, $p < .05$, $d = 0.56$) exited. In addition, the difference between Asian female non-ELLs and Hispanics female non-ELLs who were identified with ED status was found ($t [639] = 5.33$, $p < .05$, $d = 0.57$). Table 4.11 illustrated these differences.

There was a significant group difference between Asian male ELLs and Hispanics male ELLs who were identified with ED status ($t [522] = 2.25$, $p < .05$, d



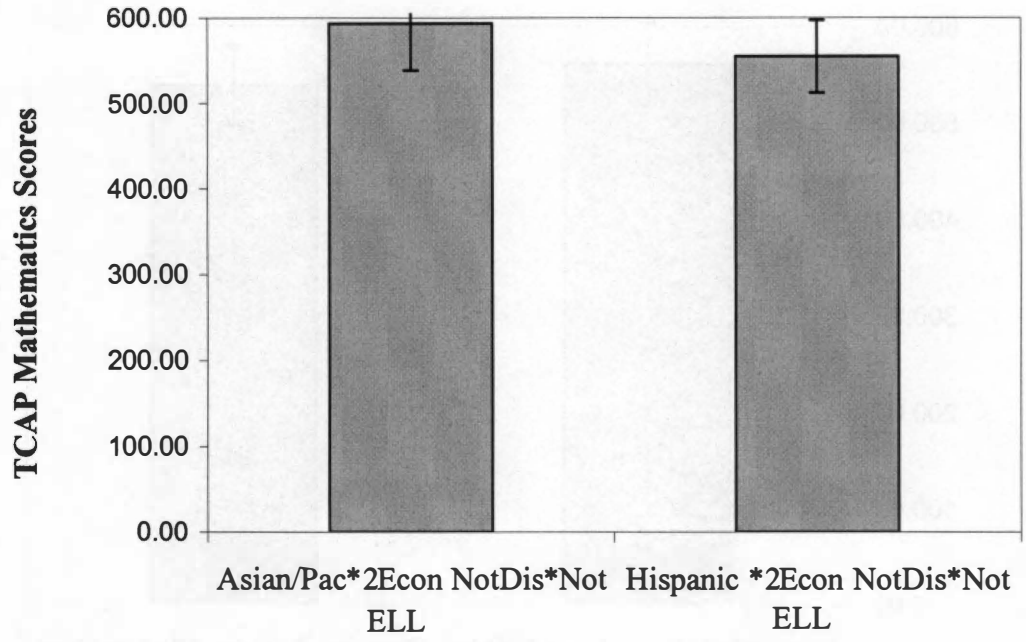
Note: Error bar represent SD

Figure 4.6 *Comparisons of fourth- grade Asian and Hispanics Students' Mathematics Achievement by ELL and Not Economic Disadvantage*



Note: Error bar represent SD

Figure 4.7 *Comparisons of eighth- grade Asian and Hispanics Students' Mathematics mean scores by non-ELL and Economic Disadvantage*



Note: Error bar represent SD

Figure 4.8 *Comparisons of eighth- grade Asian and Hispanics Students' Mathematics mean scores by Non-ELL and Not Economic Disadvantage*

Table 4.11 *Fourth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian and Hispanics female and ED students on the TCAP mathematics achievement test*

	ELL & ED				Non-ELL & ED			
Fourth-grade	**M**	**SD**	**t (511*)**	**Cohen's d**	**M**	**SD**	**t (639)**	**Cohen's d**
Hispanic female	466.65	483.64	3.58	0.56	488.43	29.60	5.47	0.57
Asian female	30.32	27.53			505.37	28.85		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*

=0.32). Similarly, the difference between Asian male non-ELLs and Hispanics male non-ELLs who were identified with ED status was found (t [640] =5.33, p< .05, d =0.55). Table 4.12 illustrated these differences.

There is a significant group difference between Asian female ELLs and Hispanics female ELLs who were identified with END status (t [84] =4.65, p< .05, d =0.98). Also the difference between Asian female non-ELLs and Hispanics female non- ELLs who were identified with END status exited (t [522] =5.26, p< .05, d =0.55 [See Table 4.13]).

There is a significant group difference between Asian male ELLs and Hispanics male ELLs who were identified with END status (t [86] =3.84, p< .05, d =0.69). Nevertheless, the interaction between proficient language skills and high SES have a substantial effect on the difference between Asian male non-ELLs and Hispanics male non-ELLs who were identified with END status.(t [433] =9.27, p< .05, d =1.03 [See Table 4.14]).

Table 4.12 *Fourth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian and Hispanics male and ED students on the TCAP mathematics achievement test*

	ELL & ED				Non-ELL & ED			
Fourth-grade	**M**	**SD**	**t (609*)**	**Cohen's d**	**M**	**SD**	**t (695)**	**Cohen's d**
Hispanic male	469.22	32.12	2.25	0.32	490.41	30.55	5.33	0.55
Asian male	479.34	29.33			507.26	29.81		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*

Table 4.13 *Fourth- grade Means, Standard deviations, and t-Test Results for the Asian and Hispanics female ELL (and non-ELL) END students on the TCAP mathematics achievement test*

	ELL & END				Non-ELL & END			
Fourth grade	**M**	**SD**	**t (84*)**	**Cohen's d**	**M**	**SD**	**t (522)**	**Cohen's d**
Hispanic female	467.86	40.02	4.65	0.98	505.69	32.61	5.26	0.55
Asian female	507.24	37.40			523.47	39.99		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*

Table 4.14 *Fourth- grade Means, Standard deviations, and t-Test Results for the Asian and Hispanics male ELL (and non-ELL) END students on the TCAP mathematics achievement test*

	ELL & END				Non-ELL & END			
Fourth grade	**M**	**SD**	**t (89*)**	**Cohen's d**	**M**	**SD**	**t (452)**	**Cohen's d**
Hispanic male	463.98	50.22	3.84	0.69	498.98	29.53	9.27	1.03
Asian male	498.74	29.99			529.27	38.36		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*

Once again, a significant group difference between Asian female ELLs and Hispanics female ELLs who were identified with ED status (d =0.76) was found. The proficient language skills and low SES have medium effect on the difference between Asian female and Hispanics female (d =0.53 [See Table 4.15]). Also those two factors have a medium effect on the difference between Asian male and Hispanics male who were identified with ED status was medium (d =0.61 [See Table 4.16]).

There was a significant difference between Asian female ELLs and Hispanics female ELLs who were identified with END status (d =1.81). Also the difference between Asian female non-ELLs and Hispanics female non-ELLs who were identified with END status exited (d =1.14 [See Table 4.17]).

A significant group difference between Asian male ELLs and Hispanics male ELLs who were identified with END status was found. Nevertheless, The proficient language skills and high SES have medium effect on the difference between Asian male and Hispanics male who were identified with END status (d =1.67 [see Table 4.18]).

Table 4.15 *Eighth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian and Hispanics female ED students on the TCAP mathematics achievement test*

	ELL & ED				Non-ELL & ED			
Eighth-grade	**M**	**SD**	**t (362*)**	**Cohen's d**	**M**	**SD**	**t (515)**	**Cohen's d**
Hispanic female	494.61	45.12	3.74	0.76	540.29	40.16	4.40	0.53
Asian female	528.78	52.29			561.53	48.02		

**Degree of freedom, M.: Mean, SD: Standard deviation, P <.o5*

Table 4.16 *Eighth- grade Means, Standard deviations, and t-Test Results for the ELL and non-ELL Asian and Hispanics male ED students on the TCAP mathematics achievement test*

	ELL & ED				Non-ELL & ED			
Eighth-grade	**M**	**SD**	**t (354*)**	**Cohen's d**	**M**	**SD**	**t (551)**	**Cohen's d**
Hispanic male	500.06	45.98	4.88	0.88	535.25	41.61	5.63	0.61
Asian male	540.63	66.18			560.58	39.28		

**Degree of freedom, M.: Mean, SD: Standard deviation, P <.o5*

Table 4.17 *Eighth- grade Means, Standard deviations, and t-Test Results for the Asian and Hispanics female ELL (and non-ELL) END students on the TCAP mathematics achievement test*

	ELL & END				Non-ELL & END			
Eighth-grade	**M**	**SD**	**t (85*)**	**Cohen's d**	**M**	**SD**	**t (494)**	**Cohen's d**
Hispanic female	494.61	45.12	7.39	1.81	550.31	38.24	10.86	1.14
Asian female	565.49	48.20			594.08	51.07		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*

Table 4.18 *Eighth- grade Means, Standard deviations, and t-Test Results for the Asian and Hispanics male ELL (and non-ELL) END students on the TCAP mathematics achievement test*

	ELL & END				Non-ELL & END			
Eighth-grade	**M**	**SD**	**t (106*)**	**Cohen's d**	**M**	**SD**	**t (529*)**	**Cohen's d**
Hispanic male	495.46	43.05	3.84	0.69	559.65	46.40	7.71	1.67
Asian male	567.27	53.54			593.20	58.21		

**Degree of freedom, M: Mean, SD: Standard deviation, P <.o5*

Chapter V

CONCLUSION

Language has a strong impact on students' mathematics achievement for Asians and Hispanics. Non-ELL students have better mathematics achievement scores than ELL students for both groups regardless of SES, gender, and grade level. These findings are in concurrence with many researchers who strongly agree that "language is a problem" and but relationship between language and mathematics education in multilingual settings is clearly complex (Abedi & Lord, 2001; Brows, 2005; Krussel, 1998; Ruiz, 1988; Setati, 2005; Solano-Flores & Trumbull, 2003).

The findings that the mathematics achievement of Asian English Language Learners (ELLs) and non-ELLs are significantly greater than that of Hispanics, respectively, regardless of gender and SES at eighth- grade in the State of Tennessee support Kaufman who found that Hispanics were more likely to come from homes where a language other than English was spoken than Asians (Kaufman et. al 1998), and Hispanics were more likely than Asians to be below proficiency in mathematics (25 versus 9 percent) among all eighth- graders.

Socioeconomic status (SES) is found strongly related to mathematics achievement for both ethnic groups. This is consistent with many researchers who pointed out that high SES generally results in greater cognitive academic language proficiency, and children from higher income families are exposed to more print and have a wider range of school-relevant experiences (Brown 2005; Krashen, 1996; Secada, 1992; Tate, 1997).

A significant interaction between language and SES was found for Asians and Hispanics in terms of mathematics achievement. A possible explanation for the findings that Asian students score significant higher than those of Hispanics at eighth- grade at the same socioeconomic status (regardless of language proficiency) is that higher proportions of Asian students come from educated two-parent families relative to Hispanics. Asian youths were more likely to attend a suburban, higher income school or private school, where a lower proportion of minorities attended (Bradby, 1992; Kaufman et. al 1998). This is consistent with researchers who report a growing isolation of Hispanic students and their overrepresentation in schools with a higher percentage of students on subsidized lunch benefits than Asian students (Carmen 1996).

On the other hand, the findings from eighth- grade mathematics achievement differences might support Kanfman's study that Asian eighth- graders were more likely to plan to enroll in a college preparatory program in high school than their Hispanic peers. Hispanic eighth- graders were more likely to respond that they "did not know" in what kind of high school program they intended to enroll. Moreover, a difference also existed in the dropout rates of the two groups: Hispanics were nearly three times as likely as Asians to drop out of high school at least once (Kanfman 1998).

This study also found that the interaction between language proficiency and SES has a small effect on the mathematics achievement differences of male Asian and Hispanics at the fourth- grade. Some scholars indicated that both of these groups share the same disadvantages that all low-SES students do: lack of background knowledge as well as lack of academic language (Brown 2005).

Although this paper is consistent with earlier reports that fourth- grade and eighth-grade Asian male and female students outperform Hispanic students, Carmen's earlier findings are not supported. He found that by the fourth- grade, Hispanic female students are already slightly behind their male peers and by the eighth- grade, both female and male Hispanic students are at the same low level of mathematics achievement. He also indicated that by the eighth-grade, the female Asian students' average mathematics proficiency level is slightly higher than that of their male Asian peers (Carmen 1996). Yet this study showed that it depends on the language proficiency and SES factors. For example, at the fourth- grade, the female Hispanic ELL students with economically disadvantage is behind the male peers, whereas the female Hispanic non-ELL students with economically not disadvantage performed better than male peers at the eighth- grade. The female Asian ELL students with economically disadvantage are behind the male peers, whereas the female Asian non-ELL students with economically disadvantage performed better than male peers at the eighth- grade.

Limitations

There are certain numbers (<10) of students did not report their language, SES, or gender status in each subgroup. The Tennessee Department of Education does not release the student results with $n < 10$ to protect privacy. In addition, the results of this study cannot be generalized to other states because the study took place in Tennessee public schools with the students having a Hispanic and Asian background.

Implications

Schools perhaps need to have intensive English training program for English as a second language learners. At the mean time, teachers might be encouraged to use the

literacy-based mathematics curriculum which incorporates the language and mathematics content to help ELL students in the math classroom. For those students who live in poor family or community, it could be great to have more financial support from nation, state, and local district educational system to establish the scholarship.

Future Research

Further research can be directed towards answering qualitative questions concerning the mathematics achievement differences between Asians and Hispanics in Tennessee local public schools: 1) Interview study of teachers and administrators to determine what other factors might contribute to the gap in mathematics achievement, and how they could accommodate and address the needs of both Asian and Hispanics students. 2) Interview with parents to explore the difference in the culture and their personal belief about learning mathematics. 3) An analysis of elementary school and middle school mathematics classes to investigate why Asian students perform better on math.

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